

Addressing the Mutual Aid Plan (MAP)

For purposes of illustration, paging, cellular and PCS services will be used as examples of commercial services which could have assisted public safety representatives in the Air Florida crash.

Today, the use of commercial paging in conjunction with existing radio equipment can relieve some of the traffic congestion which occurs as responders contend for the channels. If group dispatch communications containing discreet information like location, equipment needed, changing conditions, etc. can be off-loaded to text pagers carried by emergency response personnel, traffic loads on the MAP channels would likely decrease.

Today, MAP procedures could include group paging to accommodate broadcast announcements including the initial alert. Two-way paging could allow respondents to answer calls without having to wait for a channel, or interact directly with a dispatcher. The dispatcher could receive replies into a paging device or portable computer, and further coordinate communications without dispatcher intervention.

Notifications of emergencies could be sent to participating MAP agencies on pagers, in addition to the wireline system. On-call agency representatives could carry pagers configured for the Washington Area Warning and Alerting System. If they were away from a telephone, they could respond back to the notification system, a dispatcher or dispatch network, by sending a pager reply.

Paging systems can receive alerts directly from network-based host computers, stand-alone PCs, a dispatcher, or any of the three. A computer software program could be configured so that if a designated agency representative had not responded back within a certain period of time, an escalation procedure would activate, either alerting the dispatcher, or initiating a page to a back-up representative at the same agency.

If a MAP included the use of commercial services, it would be important to have uniform training guidelines that include training prior to an actual incident, a consistent inventory plan, registered groups with operator dispatch services, and potentially, pre-loaded groups in the paging software with up-to-date information about group leader and individual team member identification numbers.

Pagers are small, easy to store, and spares can be kept on emergency vehicles. Replacement batteries (AA or AAA) batteries are readily available. If an incident requires unexpected interoperability with an agency or organization outside of the MAP, it becomes easy to distribute activated pagers from a central location. Some commercial paging organizations now provide an idle status program, which allows agencies to activate and deactivate pagers on an as needed basis for emergency services, via a phone call to a central 24 hour a day, 7 day a week support number. Examples of the need for additional pagers might be to help coordinate activities with utility companies, or to provide information to the press, especially if there is a need to keep those organizations at a distance from the immediate scene.

Future use of GPS in conjunction with commercial paging networks will allow command posts to track vehicles equipped with AVL/paging capabilities, send messages to vehicle occupants, and provide for message responses. Message responses may include the use of a "panic button" for vehicles in distress.

In the Air Florida incident, the use of GPS tracking would have relieved communication traffic on the existing communication channels concerned with coordinating the arrival of emergency vehicles and workers. GPS information is sent automatically at specific intervals, to a central location where information matching the vehicle ID, with latitude and longitude is translated into text, maps or both. The central dispatch center could conceivably be a laptop computer at the command site.

Incident Command Structure Uses for Paging Services

A few ideas about how paging could be used in a command/control structure, based on the expanded organization chart in the Air Florida Case Study are outlined below:

When the Washington National Airport broadcast a notification of the disaster over the Washington Area Warning and Alerting System, agencies began responding by sending equipment and personnel. Today, coordination of arriving vehicles and personnel once they are rolling, can be accomplished with the assistance of commercial paging.

If, participating MAP agencies are equipped with pagers, groups have been established in the paging software or with operator dispatch, and spare pagers are available on the MAP vehicles, the incident commander will have the ability to send messages to incoming groups to:

- provide specific incident location information and changing conditions
- change intended routes due to reported traffic congestion
- change assignments as more information becomes available
- determine estimated time of arrival for each MAP vehicle

A message could be sent asking for ETA. Replies can be easily originated from a paging device or a handheld device interoperable with a pager. For example, a message from the incident commander may read, *How many minutes, ETA?* The reply could simply be, *1, 10, 45, etc.*

Determine the quantity and types of supplies & equipment coming in, to know whether to dispatch for more. For example, an incident commander may send a broadcast message to all incoming units that reads, *Do you have the following? (see replies).* The unit replies may read, *extra blankets, bandages, life vests*

The responder only has to select the appropriate responses from the choices given. The command post can automatically determine who sent the response and log the information accordingly.

Off-loading incoming unit coordination communications to paging should free up mutual aid channels for those already on the scene.

Medical units need to stay in touch with local hospitals. Participating hospitals within a MAP jurisdiction need to be prepared for the incoming injuries. Designated hospital personnel can wear two-way pagers during the course of an incident in order to receive messages from on-site rescue workers. On the-scene public safety rescue workers and/or staging personnel can be equipped with a palm-sized HP200LX that has two-way paging software that allows workers to access a directory of contacts at local hospitals. On-site workers can send messages from the HP200LX via a pager cable connection, to local hospital personnel, alerting them of ETA, the number and the extent of incoming injuries.

On-the-scene supply units can stay in touch with mobile rescue workers to send text messages announcing incoming supplies, and ask individual task groups what is needed by providing them with a selection of canned responses, or allowing them to send freeform responses from message origination pagers.

Staging area personnel can send group messages to rescue workers, providing them with logistics and transport information, along with any changes. Rescue workers can send freeform messages from message origination pagers or a palmtop device back to staging areas to alert them to the number and extent of incoming injuries.

The food unit can provide up-to-date information to personnel responsible for scheduling rescue worker and/or victim meals, keeping everyone informed about logistics on receiving meals, and updates on food supplies available.

The compensation unit can receive authorization for payments from incident command personnel, and have a history log of requests made, and authorizations received.

Ground transportation can be easily coordinated with two-way paging directly to vehicle occupants and visa versa. Air control can be coordinated with ground dispatch, however ground-to-air, or air-to-ground communications will only work when airborne vehicles are within range of transmitters. Helicopter communications in major metropolitan areas, where transmitters are densely configured should work.

Where helicopter communications work effectively, passengers can receive requests from the ground to search specific locations, rescue victims, and/or deliver supplies. Helicopter passengers can send short messages back to control personnel on a message origination pager and/or palmtop letting them know the extent of the situation directly to their two-way units, without having to go through a dispatcher.

Demobilization activities can be coordinated to allow commanders to send notification for break-down, departure or changes in plans to group participants. If a participant is not ready, he/she would have the ability to notify the command from the paging device.

The documentation unit, can check communication data logs from the dispatchers' PC(s), pages stored in the units themselves and/or the provider's network operating center(s) to help construct their reports.

Multiple incidents

Where multiple incidents occur simultaneously, like the metro crash which occurred during the rescue efforts responding to the Air Florida airplane crash, commercial paging services can help. Since paging infrastructure is not limited to one jurisdiction, dispatchers can access commercial paging networks as a common way to achieve cross-jurisdictional communication. Personnel located outside of the immediate jurisdiction where an incident takes place, have the ability to communicate with one or more individuals within the jurisdiction, on a device-to-device basis or a dispatcher-to-device-to dispatcher basis.

Interoperability on a device independent, infrastructure dependent basis

a) Participating Mutual Aid Plan public service organizations, like the utility companies, may use their own local paging providers during normal operations. Paging software can now allow MAP dispatchers to send messages to digital and/or alphanumeric pagers from a single directory and user interface, even though the pagers reside on multiple networks. That means that utility companies can use their existing equipment as long as dispatchers have the appropriate software on their computers, along with the appropriate pager identification numbers listed in their directories. Dispatchers can send messages to news media personnel in the same manner.

If a MAP calls for the centralized management of pagers across agencies and/or organizations, some providers will offer those services, even though the pagers operate on multiple networks.

On two-way networks, peer-to-peer communications are possible between two-way pagers in multiple jurisdictions where coverage exists. Coverage is the strongest in the major metropolitan areas.

b) Commercial providers using other technologies have already recognized the need to interoperate with paging providers on a device independent, infrastructure dependent basis. They are working together to develop gateways to move data messaging traffic across diverse infrastructures, where the goal is to deliver information to individuals based on their requirements for specific form factors, enhancements or coverage. Today, a message could be originated on a satellite terminal located outside of the United States and delivered to a pager in the United States. A two-way pager can then send a response back to the satellite terminal originating the page.

Discreet data messaging helps rescue workers:

- a) net it out. They are forced to communicate in an efficient, abbreviated manner.
- b) keep a history log. After the fact, it is often necessary to reconstruct who said what to whom.
- c) communicate without the aid of a dispatcher minimizing potential for human error, expediting the communication process, and freeing mutual aid channels for voice communications.

Cellular/PCS definitions

a) Cellular.

Cellular in this usage denotes a commercial radio-telephone service enabling a subscriber to make and receive telephone calls with no operator intervention. The transmission path, once established, may be used to transmit voice, data or video information. Cellular service was first authorized by the FCC in 1982. In any of 734 Metropolitan or Rural Service areas (MSAs and RSAs), there are two cellular licensees, each of which is authorized to operate systems using 25MHz of spectrum in the 824-849/869-894 MHz range. Because all cellular systems operate on the Advanced Mobile Phone System (AMPS) air interface, all cellular phones are capable of operating on all cellular systems in the United States, irrespective of ownership or manufacturer. As of December 1995, the CTIA estimates that there are some 33.8 million cellular subscribers using over 22,600 cell sites in the United States. Other industry sources estimate that over 95% of the population of the United States lives within range of a cellular telephone system.

b) PCS.

Personal Communications Services (PCS) were authorized by the FCC in 1994. Like cellular, the principal use of PCS will be to provide direct dial radio/telephone service, with a variety of new services as well as integration of telephony with paging and other data services.

Three 30-MHz blocks and three 10 MHz blocks of spectrum in the 1850 - 1990 MHz band of the radio frequency spectrum are allocated to PCS systems. Licenses are being auctioned off by the FCC. A and B block licenses, which grant rights to operate on 30 MHz of spectrum within very large geographic areas of Major Trading Areas (MTAs) were awarded in April of 1995. C-block auctions, which include the right to operate on 30 MHz within smaller geographic areas designated as Basic Trading Areas (BTAs) concluded in May of 1996. Two systems are in commercial operation in the Washington-Baltimore MSA and the Honolulu MSA, with numerous system launches anticipated for late 1996. Unlike cellular, no standard air interface was mandated by the FCC, so a variety of digital air interfaces will be deployed within the PCS allocation. The digital interfaces offer improvements over analog systems (such as AMPS cellular) in system capacity, signal quality, privacy and feature sets.

Capabilities Analysis

The case study notes flaws in three basic areas:

- 1) situational problems
- 2) organizational problems
- 3) communications problems

To varying degrees, the widespread availability of wireless telephone devices would have had a positive impact on the management of the situation, as outlined below:

a) Notification

The key to the role that cellular and PCS systems might have played in the Air Florida disaster begins with the fact that the first notification of the accident was transmitted via mobile telephone. At the time of the accident, there were only about 150,000 mobile telephones in commercial operation, with the Improved Mobile Telephone Service, or IMTS, being the most advanced technology available. Although IMTS is a direct dial technology that required no operator intervention, it was technically possible to use IMTS units to hail a mobile operator on an older so-called manual system, in which the mobile operator would place a call after receiving verbal instructions from the mobile unit operator.

Both CB radios and IMTS mobile units have largely been displaced by the wireless telephones in service today. Every day, some 50,000 calls are made to 9-1-1 and other emergency numbers from wireless phones, and the wireless industry has collaborated with the National Emergency Number Association (NENA), the National Association of State Nine-One-One Administrators (NASNA) and the Association of Public Safety Communications Officials (APCO) to ensure that public safety requirements are met.

Undoubtedly, the Washington area Public Safety Answering Points (PSAP) would have received numerous calls within seconds of the Air Florida crash onto the Fourteenth Street Bridge. The numerous calls would have provided Public Safety officials with a much more refined picture of the situation at hand, perhaps allowing for more efficient deployment of personnel and equipment. Unfortunately, as the report states, "most witnesses were in their cars and unable to report the incident since cellular telephone service hadn't been implemented yet."

b) Inadequately Informed Responders

As outlined above, commuters and other eyewitnesses using wireless phones would have proven to be a valuable source of information about the accident site, enabling better information to reach the various response teams.

c) Telephone Overload

Although wireless phones depend upon the underlying wired telephone network, their facilities do not necessarily overlap. Congestion on the telephone network may have been bypassed by wireless telephone systems. Many calls that were blocked owing to overload in the serving central office would have been successfully completed on a wireless system. It must be recognized, however, that cell sites themselves can easily become overloaded immediately following an unusual event. In fact, there are generally fewer possible cross-connect paths in the cell site itself than there are in the wireline system.

d) Manual Patching

The requirement for command personnel from different response teams to speak with one another could have been handled with the use of wireless telephones, thus freeing the scarce radio channels for tactical applications. This assumes that the caller could call into a facility which had conferencing or call forwarding capabilities. It must be recognized that although possible, these connections take time to establish.

e) Hospital Communications

Emergency medical teams could have utilized wireless telephones to place telephone calls to emergency rooms of hospitals, thereby communicating the number and condition of incoming victims to aid in their rapid treatment.

In general, wireless telephones would have been an asset in facilitating command and control communications between the twenty participating agencies. By using wireless telephones for those functions which could be handled in the point-to-point mode inherent to wireless telephony, scarce radio channels would have been freed up for use in the tactical working groups. Also, the spectrum-inefficient patching (which ties up two or three channels to sustain one conversation between incompatible radio systems) could have been greatly reduced or eliminated by the use of wireless telephones.

Wireless telephone systems, especially mature ones, have tremendous capacity. As the report noted, "as response builds and tactical teams deployed, the current designated mutual aid channels quickly become overloaded. As this occurs, the functions suited to a telephone environment but which also require portability, could be offloaded to wireless telephony systems, again preserving scarce channels for tactical demands. The already-robust capacity of commercial wireless systems might be further enhanced by the deployment of a priority access capability, which would create a hierarchy of access granting priority to the public safety community.

Cellular Data

This report has focused solely on the voice capabilities provided through wireless telephone service providers, but numerous data transport capabilities currently exist that would

have been of use in the Air Florida disaster.

At its simplest level, the cellular telephone provides data transport capability just like any other telephone circuit. Thus, essentially any facsimile or circuit-switched data application capable of operating over a wireline phone circuit can operate via a cellular phone. Had portable facsimile machines been available in 1982, they could have been used to fax site sketches to various responding agencies through cellular telephones, enabling considerable refinement in the deployment of personnel and rescue equipment. Similarly, digital cameras, unavailable at the time, could connect to a laptop in the field to transmit photographs of the scene for analysis at remote locations. And, the broadcast capabilities inherent in email networks could have been easily accessed via a keyboard or laptop linked to a LAN via a cellular dial-up connection. Again, less time-critical information could have been transmitted via wireless telephones to preserve the scarce tactical communications capacity. It must be recognized that these messages generally take longer than most public safety voice messages, and while underway they lessen the cell sites' ability to handle more intermittent voice traffic.

In addition to the circuit-switched capabilities consistent with the capabilities of wireline telephones, wireless services also offer packet-switched capabilities. The Cellular Digital Packet Data (CDPD) protocol offers the potential of integration seamlessly with the TC/PIP protocols in universal use, allowing full data interoperation. Coupled to a Global Positioning System (GPS) receiver, such CDPD modems would enable automatic position reporting of vehicles and other rescue equipment which would have assisted in more efficient deployment. At the time of this report, CDPD is in its infancy in deployment and its full capabilities have yet to be tested.

12.9.3.2 Major event preparation

12.9.3.2.1 Overview

The upcoming Summer Olympics in Atlanta, Georgia will use non-traditional wireless services for public safety. Arrangements include the use of radios, cellular phones and pagers.

12.9.3.2.2 Private network support

Law enforcement supervisors will be outfitted with private radios. However, 1700 law enforcement officials will be outfitted with text pagers operational on a private, Georgia statewide network. The infrastructure includes 68 transmitters around the State. The six Atlanta-based transmitters will include redundancy at each location. An additional fourteen transmitters will have redundant backup. Multiple commercial lines will run to the inter-exchange carriers. The central operating center which houses store-and-forward messages, will have "hot" standby capability.

Computer terminals and dumb terminals will allow command posts and designated centers to send individual or group pages.

Alpha paging was selected as an alternative to radio dispatch for several reasons:

- 1) Private radio was determined to be too difficult to operate in high noise level operations. There was a concern that instructions would be difficult to hear.
- 2) Instructions would be printed out on the LCD screen of the alpha-numeric pagers, so there would be no need for the recipient to call in, to have the instructions repeated.
- 3) Most of the information transmitted will not require a response. It will primarily direct the activities of groups of officers.

Commercial wireless services

Additionally, 2500 commercial pagers on a single frequency, are anticipated to be distributed for operations by the Olympic Committee. They will be used by the Committee to communicate with ushers, guides and couriers. VIPs will be offered a commercial package that includes a digital cellular phone.

Fifteen thousand reporters will be offered packages to include a choice of devices supported either by SMR or cellular. Event results will be broadcast via wireless e-mail to laptops.

Intelligent Transportation System demonstration:

The Federal Highway Administration has a Traveler Information Showcase package called Project Peachtree that will allow VIPs to receive a palmtop device loaded with a memory card containing digital maps and yellow pages information, and a two-way pager. Turn-by-turn route instructions, as well as traffic updates, can be obtained automatically by sending a page which will access the TIS's main data server in Atlanta. The response will be sent back to the recipient through the two-way paging network. Visitors don't have to disturb law enforcement personnel for directions, allowing them to focus on public safety activities.

Recommended Study

When the Olympics are over, it may be interesting to study what impact the preplanning process for wireless communications had on the success of the event, and what changes, if any would be made for future events.

12.9.3.3 Commercial Wireless Service Applications in the Public Safety Environment

Current uses in Public Safety

According to an article in Communications, August 1994, entitled, 1994 Public Safety Profile, Radios, pagers, and mobile data terminals and laptops are out there in abundance. If you were to compile a profile of the "average" professional, his/her agency has the following in the field: 304 mobile two-way radios; 293 handheld two-way radios; 260 pagers; 209 dedicated mobile data terminals; 12 laptops; 34 cellular phones and three AVL units...Fully 57 percent of the respondents say that there are no repairs done in-house.

Services Used by Federal Agencies

Satellite

Currently satellite technology is used primarily for incident communications in remote areas of the country where private radio or cellular infrastructure does not exist. It is also used where emergency communications are needed while fighting wildfires to remote fire camps. Satellite based GPS is used for vehicle tracking on prisoner transport buses traveling through remote locations. Several federal agencies carry mobile satellite terminals for wireline backup and wireless communication in the event of a catastrophic system failure. Satellite terminals are also used for secure voice, fax and data communications, telephony, facsimile hard copy data transfer, data file transfer, position reporting and high speed data, supporting imagery and mapping. Video teleconferencing supports teletraining and telemedicine applications. A recently introduced satellite provider has placed 500 satellite radiotelephones into the public safety market during its early months of commercial service. These are used for law enforcement, disaster response, emergency medical services, forestry support and regular operational communications.

Paging

Paging is thought to be a way to achieve limited low cost interoperability between federal, state and local law enforcement agencies. It is commonly used throughout the federal government. When immediate notification of key personnel is required local or nationwide paging services are often used. Some agencies travel with portable paging transmitters to use in remote locations. Newly introduced two-way paging services are used for the message store-and-forward capability, so that when personnel leave a coverage area and return, they still receive their messages. Agencies also use the two-way services to receive confirmation that a recipients have received their messages. Paging is an effective alerting tool, but it may not be appropriate in time critical or mission critical applications.

Cellular

Cellular communications is used to achieve interoperable voice communications between federal agencies, and to facilitate coordination efforts, or arrange logistics with state

and local agencies. Cellular is a unit-to-unit system and does not currently support broadcast requirements unless some system related conference calling capability is available. Cellular services supplement the Federal Government privately owned land mobile radio systems where there is a need for nation-wide wireless voice communications. Cellular services are also used for criminal investigations, covert operations, logistics, interoperability between jurisdictions and task force operations involving several disciplines. Additionally, they are used by protective support agents for the President and Heads of State.

Services used by State and Local Agencies

Cellular

- a) The Governor's Office of Emergency Services for the State of California indicated that over 4,000 cellular phones were used during the Northridge Earthquake. The Agency itself uses 450 cellular phones.
- b) Bergen County Police in New Jersey are trialing CDPD with the use of Mobile Data Terminals.
- c) The Virginia Department of State Police uses 175 cellular telephones for voice transmission.
- d) California State freeway call boxes use cellular phones. The California State Highway Patrol has responded to numerous callers.
- e) The California State Highway Patrol uses some cellular phones.
- f) The New York State Police use cellular telephones for Hazardous Material situations, certain investigative and coordinated arrest activities, and other administrative activities. Cellular telephone service is usable along the major arteries in population centers. They use cellular telephones for time critical communication and where coordination in a flexible environment is an essential requirement.
- g) Cellular is the back-up system to the traditional public safety dispatch radio and MDT trunked 800 Mhz frequency in the city of Plano, Texas.
- h) Groton, Connecticut Police Department uses CDPD with mobile data computers for messaging and to query the National Crime Information Center run by the FBI and motor vehicle bureaus throughout the country. Public safety officials can wirelessly exchange forms or messages from their vehicles or desktops within seconds. Previously, if an officer needed certain information, he/she had to call into the dispatch operation to get someone to pull the data and they relay it verbally. This was a slow process and discouraged people from asking for what they needed. (Ref. ISCWG9025)

i) The Alexandria, Virginia Police Department is evaluating the use of laptop/notebook computers in conjunction with CDPD to request tag checks, wants and warrants from the cruiser.

j) The Mesa Arizona Police Department has eight mobile computers operating over a cellular network which provides integrated voice, circuit switched data, and CDPD transmissions. Mesa's utilization is to access Mesa data applications other than criminal history files. Mesa also uses 325 units in their own data system which do not support criminal history inquiries.

k) Jefferson Borough, PA, uses mobile computers operating over a cellular network, paying a flat fee to a cellular provider for unlimited usage.

l) The Philadelphia Police Department has plans to install 70 laptop computers into Philadelphia Police vehicles to give officers access to reliable, timely information before they approach a vehicle, house or suspect, allowing them to accurately assess potentially dangerous situations. The software allows officers to connect to national, state, and federal data bases, police computer, the National Crime Information Computer (NCIC) and the Bureau of Motor Vehicles.

The Philadelphia Police Department may eventually equip more than 1000 vehicles with CDPD capabilities.

m) The California Department of Forestry and Fire Protection has cellular phones installed in all of their Chief Officer command vehicles statewide. The Majority of their Command Centers have access to one, in case of a catastrophic in-house telephone system failure.

Paging

a) The Governor's Office of Emergency Services for the State of California uses a total of 768 pagers, 237 of those classified as numeric, with the remaining 531, classified as text pagers (or alpha-numeric).

b) Bergen County Police in New Jersey use alphanumeric paging to dispatch weather information to emergency management coordinators in the County's seven municipalities.

c) The Virginia Department of State Police uses 500 numeric pagers.

d) The California State Highway Patrol uses many leased pagers.

e) The California Department of Forestry and Fire Protection maintains hundreds of pagers-including alphanumeric-throughout the state of California. The pager are of two configurations...in the radio frequency spectrum for alerting

personnel of an emergency incident, and secondly, pagers using commercial vendor telephone systems for administrative type messages.

Satellite

a) The Governor's Office of Emergency Services for the State of California has 8 INMARSAT transportable terminals. They use OASIS Hughes Satellite Systems with 2 major hub terminals, 60 earth stations and 5 trailer mounted stations.

b) Bergen County Police in New Jersey use fixed satellite services for weather information and flood gauge information.

c) The Virginia State Police are planning to purchase three mobile satellite terminals for emergency backup communications.

d) The California State Highway Patrol has two satellite telephones.

e) The California Department of Forestry maintains five mobile communications units statewide. These units, capable of stand-alone operation, have satellite systems on-board, along with the full array of equipment necessary to communicate with the multitude of resource normally assigned to "all risk", multi-agency incidents in the State. They are also purchasing units packaged in suitcases for use in remote locations, or outside cell site areas.

Specialized Mobile Radio (SMR)

a) The Virginia Department of State Police has begun a mobile data project where 50 patrol cars will be initially equipped with mobile computer terminals. Since state-wide coverage is required, radio transmissions will be through several wireless service providers. The network will be expanded to 350 vehicles after the initial deployment.

b) The California State Highway Patrol is using leased services for data transmission in several parts of the State with significant expansion planned.

12.9.3.4 Examples of current public safety applications

Portable Systems

a) Satellites

Public safety agencies can now obtain and store in secure locations small aperture satellite terminals which operate under standby agreements with the various carriers. These small terminals can be man-carried in two or three suitcases, and will operate on batteries long enough to establish permanent power. It is necessary to obtain at least two terminals. When a storm or other occurrence eliminates a

microwave tower or terminal, the portable SAT is deployed to the terminal and the far side of the breach. This provides a link via the satellite between the isolated point and the surviving connection to the system. A California Emergency Satellite Communications System proposal is now being reviewed by a task force representing a number of State of California agencies including the Highway Patrol and Department of Motor Vehicles¹⁶. These units are effective in administration and logistical uses. They may not be appropriate for tactical types of operations.

b) Paging

Some paging providers have developed portable transmitter systems that can be deployed for emergencies where there has been a disruption of normal service. The transmitters are stored in hard cases on wheels, packaged as "shippable" containers. Portable transmitters have been used extensively during cleanup efforts following floods, hurricanes, disasters relating to marine spills and remote investigation work.

c) Cellular

Some cellular companies offer portable cell sites on wheels (COWs). When Hurricane Opal hit Panama City, Florida, COWs were rolled in to assist with the recovery efforts.

Disaster Recovery

a) Special Mobile Radio

After the Northridge earthquake the Red Cross, Federal Emergency Management Agency (FEMA), California Office of Emergency Services and the Los Angeles County Emergency Operations Center received 82 mobile dispatch special mobile radio units to assist workers in establishing a communications pipeline to coordinate the Red Cross' efforts with other disaster relief teams in 18 cities. The devices were mobile units and multi-service digital terminals that gave agencies the ability to coordinate efforts through digital cellular text messaging and digital dispatch capabilities. They contained features including Private Network Dispatch, which allowed each agency to establish individual or group communications to link relief efforts to specific areas, and it guaranteed message delivery, giving the Red Cross and other agencies instant access to each other while using only a limited band on congested airwaves. Each disaster team was able to monitor each other's needs over a wide coverage area. Volunteers used the handsets to coordinate activities required to serve nearly 300,000 meals and deliver supplies including toothbrushes and blankets for more than 15,000 displaced residents.

¹⁶ ref.1, APCO Bulletin article, Applications for VSAT Satellite Systems in Emergency Management, March 89

b) Cellular

During the Georgia Floods of 1995, the American Red Cross used cellular phones for their tri-state relief operation. It allowed agency representatives to get vital information about needs in the field to headquarters and warehouses so assistance could quickly be dispatched to those in need.

A tornado struck Albany, Georgia, injuring 36 persons and causing substantial property damage in the Fall of 1995. Disaster recovery agencies including the City of Albany and the Dougherty County disaster Relief Team used cellular phones which allowed officers at the command center to communicate with officers on the streets in a timely manner.

Back-up

With only four telephone company central offices (COs) in Plano, Texas public safety officials must prepare for any possible disruption to phone service. Should one or more of the COs be damaged and cease operations, cellular communications allows public safety officials to remain in contact with hospitals and utility companies.

A large shopping mall in Plano, Texas served as the catalyst for a new ordinance requiring builders to include a conduit system for wireless communications microcell systems. Because the mall is built on the side of a hill with parts of the structure underground, police and fire department personnel have had emergency radio contact with the dispatch center prematurely terminated, or have found traditional dispatch communications unavailable. When radio communications fail, the only available communications source is telephone communications, usually involving cellular phones.

Reports/tickets

a) Incident Reports

Officers will utilize a CDPD system to enter incident reports from the scene via mobile terminals currently being tested by the Alexandria, Virginia Police Department.

b) Parking Tickets

Parking meter attendants carry a portable wireless terminal to write tickets, and send the information back to the office. This application could be supported on most commercial wireless data systems.

c) Community Policing

Some local law enforcement agencies provide a cellular telephone to their officers involved in community policing. Community residents are given the cellular telephone number to report suspicious activities or provide information. Community residents are encouraged to direct all non-emergency calls directly to the community policing officer by calling the cellular telephone number. This reinforces the bond between the community policing officer and the community. It also off-loads dispatch traffic since the officer is, in effect, dispatched by the citizen who is directly calling for service via cellular, as opposed to the radio dispatcher via the PLMR system.

Call Boxes

Call boxes containing telephones are often placed along freeways and on campuses to provide a measure of safety for the general public and a means to call for help. Today, cellular service is primarily used for these connections. Satellite, PCS, SMR or paging could also be used for this application. An interactive voice response message could direct callers to page for specific help, or provide an option to go directly to a live dispatcher.

Status updates

Two-way paging devices can allow public safety representatives to send one or more canned messages to a dispatcher, or other personnel monitoring the activities associated with a specific incident. Those messages could include officer status information (in-service, at-the-scene, out-of-the vehicle, etc.), or sensitive information that should not be scannable by the public or overhead by the public within ear-shot of a public safety radio speaker. A data log containing date/time stamps with each transmission make incident report writing much easier and more accurate.

Portable Telemetry

a) Vital signs

Emergency Medical Service workers use telemetry to provide patients' vital signs to destination hospitals. Some agencies are experimenting with using CDPD to send this information to free-up PLMR channels. The traffic load fill-in characteristic of CDPD makes it cost effective. However, in some EMS management regions primary use of cellular telephone service for the transmission of biomedical telemetry is not authorized because the availability and continuity of such transmissions cannot be ensured.

b) Equipment Monitoring

Software can be written to monitor vehicle engine performance, and when necessary, transmit a wireless message to a dispatcher or maintenance shop personnel

to call the vehicle in for repair. Messages can be sent via CDPD, two-way paging, satellite, PCS or SMR.

Fixed Telemetry

a) Emergency weather information

Satellites are used to relay, from fixed monitoring points, information on weather conditions, flood level conditions, etc. to keep tabs on emergency weather information.

b) Security

Commercial wireless data services are used for remote monitoring of building doors, alarm systems. Messages can be sent via paging, satellites, PCS or cellular CDPD.

c) Highway signs

Portable message signs can be set up along the side of highways to advise the public of hazards and/or road closures ahead. As conditions change the message signs can be updated without need for actually driving to the sign and manually changing the message. Most commercial wireless data services could support transmission of those messages in conjunction with an integrated software application.

d) Vehicle monitoring

Fixed points are established gather information and relay wireless messages regarding truck weight and motion. This enables the highway patrol to detect illegal trucks from 5 miles distance. Software integration with most commercial wireless vendors is required to support this application.

Distress alerting

a) Security personnel

Security personnel can carry a two-way pager to send a canned message to the local police and/or fire department to report an incident, and send location information.

b) Global Positioning Systems

Automatic Vehicle Location (AVL) is used to determine longitude, latitude. A Mayday system which is planned for the consumer market in automobiles they purchase, will activate during an emergency (possibly via expansion of airbags) to automatically signal an emergency dispatcher with location information. Field trials

are currently being conducted. Commercial satellite and paging services are being used to transmit emergency alerts. Where traditional GPS accuracy is not sufficient, differential GPS corrections are available via commercial satellites.

Remote Control

a) Canine Units

Most commercial wireless data technologies can be integrated with software containing control commands. Messages can be transmitted across most networks that would, for example, automatically open a patrol car door for canine units to release dogs if the officer were away from the auto and immediate danger was impending.

b) Traffic light control

A command could be sent to activate traffic signal pre-emption during emergencies or pursuits. Authorized agencies could change upcoming traffic lights from red to green to facilitate the pursuit.

Air Surveillance

Voice and data messages can be transmitted from aircraft to ground dispatch or command personnel via satellite. Terrestrial based systems would not be able to provide consistent coverage across remote locations and certain terrain. At the present time, virtually all state and local government air-to-ground communications for agency tactical operations is handled on agency owned operations systems along with the rest of the agency's field traffic.

Database queries

Public safety personnel already have the ability to send queries to the National Crime Information Center, Department of Motor Vehicles and hazardous materials (HAZMAT) databases, via mobile data terminals on CDPD and SMR networks databases. Many are able to access other federal, state or local databases as well. These inquiries offer a direct connection without human intervention, or transmission over private radio spectrum. Security of criminal history information may be subject to state and federal law which could limit their applicability within commercial networks.

Alert Notification

Databases can be configured to perform an automatic outdial to one or many public safety individuals carrying pagers. Computer-based first notification applications could alert public safety personnel at home via pagers, should an impending event, like a tornado, hurricane or other type of occurrence require their response.

Group calls

Satellite technology permits up to 16 talk groups per handset as well as establishment and reconfiguration over the radio channel within a few minutes with no local operator intervention. SMR supports dynamic regrouping. Paging technology permits group messaging.

Personal productivity

Cellular phones and pagers have are now often used by management level public safety representatives to provide them with the freedom to be out in the field close to their team and the community while retaining the ability to handle communications that would otherwise keep them in their office.

12.9.3.5 Examples of future public safety applications

Remote control

Remote control sensors could monitor vehicle direction and speed via intelligent software, and could send a commercial wireless message enabling a collision over-ride command, to force a vehicle to stop or slow down when in immediate danger of impact. Additionally police could stop a fleeing vehicle via circuit board melt down, or disabling the engine in some manner. Responses could be transmitted to police officers on their wireless data inquiries containing a vehicle's identification number, license number and (with GPS) the current location of a stolen vehicle. Consumer automobiles would need to come equipped with the appropriate hardware and software to make these types of applications possible.

Early warning

The first step in mitigating the effects of a disaster is to warn those who are most at risk. Towns isolated by difficult terrain from main population centers are particularly vulnerable. If the normal communication lines are disrupted, there is no way of informing the community of the impending danger or advising them on how to prepare. A Low Earth Orbit (LEO) satellite system will not be tied to terrestrial interfaces. Therefore handset that are in the affected area will be able to receive the information needed to adequately prepare and save lives and property. An example would be to have an emergency LEO based handset at a local health clinic.

Assistance and relief

Typically there is a two to three day lag between the arrival of relief teams in response to a disaster, and establishment of a communications network to assist. During that period of time, before an emergency high frequency communications network is established, satellite handsets can be used in field operations. Even after

an emergency communications network is erected, satellite handsets will allow relief workers to roam beyond the footprint of the high frequency network, and into areas where there is no available infrastructure.

Distress alerting

*...consider a police officer stopping a motorist in a remote area. He advises his dispatcher via voice that he is on county road X, and is stopping a motorist with a broken tail light. He then leaves his car and proceeds toward the motorist. He then notices a weapon being pointed at him. The officer ducks behind his car and pushes the emergency button on the... (satellite) terminal his belt (10 oz.) as he draws his weapon. The system automatically sends a preprogrammed alerting message and the precise location of the scene to the dispatcher. The dispatcher acknowledges and sends backup, the message received light illuminates on the officer's terminal, confirming to him that help is on the way precisely to his location, **without a word being spoken.** Dramatic, yes, but in routine use a much more common situation might be one wherein a single channel is overcome with congestion due to a relatively minor traffic mishap or interference and contact with a needed officer cannot be established. Dispatch simply types a quick message: Proceed to 5th and Main St. Assist MD St. Pol. Unit. His address is MSP-I-12. Not only does the message tell the officer where to go and what to do, but provides him with the ability to use his terminal to be interoperable with the unit he is going to assist. The officer acknowledges the message without saying a word or struggling with a congested channel¹⁷.*

12.9.4 Commercial Interoperability

12.9.4.1 Current interoperability

Public Safety agencies have the ability to tap a goldmine of resources that are currently available in the private sector. It should be recognized that these commercial solutions have typically been between two units, and have not supported immediate broadcast to multiple units, although a number of providers are developing technologies and procedures to address this capability.

a) Multi-frequency communications in an ECOMM situation

Today there is a Mutual Aid Plan (MAP) that provides an Incident Command Structure (ISC) for its responding agencies. Although the ISC provides a plan for Command and Control, implementation to the fullest extent remains a challenge due to limited communications capabilities.

¹⁷ pg. 32, of ISCWG9048, Maryland Law Enforcement Telecommunications Interoperability Analysis, produced for The Maryland State Police in October 1993.

Using commercial-off-the-shelf (COTS) products and services, with limited R&D, it is feasible to develop an electronic switching matrix that will have the capability to provide full cross band, multi-mode, secure to unsecure RF communications. This would require cooperation between agencies (local, county, state and federal) and the commercial sector. This system could be developed by a cooperative venture between the commercial and public sectors. This system could also provide cross connects to satellite links, local telephone interconnect and microwave relay stations if necessary. The effort would require planning and communicating with each of the participating agencies and commercial sector companies.

b) The use of commercially available multi-format voice & data equipment in the public sector

A fully integrated system can have total interoperability with other agencies without discarding their current voice and data system.

Interoperability is a key issue which needs to be considered by public safety agencies as they plan the integration of new technologies into their existing systems. Digital system integrators have been successful in the commercial sector with the proliferation of client/server applications and the globalization of branch internetworking.

An emerging technology that lends itself well to wired and some wireless system integration is Frame Relay. It is a low delay, high performance system with on-demand bandwidth efficiency. It reduces transmission line costs, reduces equipment costs, provides a multiprotocol encapsulation and a single physical connection to the network. Frame Relay Devices can work with any RF system that would provide a full duplex channel with a low Bit Error Rate (BER). Testing would have to be done to ensure that the RS232 Port (19.2kbs) on LMR equipment would be compatible. Frame Relay devices may not be applicable with the current narrowband LMR wireless environment, but can provide a gateway between current LMR systems and other RF systems as well as to land-based communications command posts.

With frequency allocations at a premium, the commercial sector has been able to use major voice and data compression. A typical voice channel is 64 Kbs. Commercial integrators have produced systems that reduce a single voice channel to 8Kbs with the clarity of a 64Kbs channel. This means an agency could have up to 8 voice channels where they currently have one voice channel, if they have enough bandwidth to support a 64Kbs data rate. LMR channels currently support up to 19.2 Kbs data rate.

In the case of a major catastrophic event, this allows the Public Safety Sector to have eight times the capacity of a standard voice grade circuit, producing a major increase in capabilities. In times of non-emergency communication, the bandwidth requirements can be reduced, producing lower monthly operating costs. FCC rules and

frequency allocation changes would be necessary to support the 64 Kbs data rate on LMR channels.

One integrator has been able to multiplex SNA data from mainframe to mainframe, or mainframe to remote controllers and LAN traffic, all on the same circuit. They have developed the capabilities to cross-link simple key systems on one end, and a full-blown PBX with E&M signaling on the other end. Currently, this is not applicable on LMR channels.

They have identified a way to integrate two-way radios into a Frame Relay Multiplexer. This would give the end-user the ability to use their standard key system or PBX on one end and access a two-way radio on the other end of the circuit to communicate with their field staff. This communications can be secure or non-secure depending on the application. The link between locations can be a hard-wired link or an RF link. Currently, they are using 2 Mbs spread spectrum microwave links on a routine basis. Such links are infrastructure extensions; they can be of support in tactical situations to remote command posts.

Current technology has provided the ability to have a central site with an omnidirectional antenna with 6-8 sites on line, using directional antenna arrays. Each site can have compressed voice, LAN traffic, mission critical data, i.e. SNA & other legacy protocols, fax, one and two-way paging and video conferencing on these circuits. This technology even provides the ability to prioritize delay sensitive traffic. Such links are infrastructure by design. They can be of support in tactical situations to remote command posts, but may have limitations to current mobile and portable communications systems.

Frame Relay is just one of the new emerging technologies that offer high speed multimedia applications with an optimized throughput and response time over lower speed networks. Their applicability in a LMR wireless environment depends upon the availability of suitable bandwidth.

There are currently hundreds of major corporations around the world that are using this technology, and they have incorporated both public and private voice/data networks into their overall telecommunications infrastructure design.

c) Gateway technology for data communications

Gateways consist of computer hardware and software that allow networks to communicate. Internet communications have been conducted via gateway technology from the time it became operational. Communication via the Internet is achieved across thousands of disparate networks located throughout the world.

Many commercial wireless vendors conduct data transmission via the Internet today. Paging vendors allow pages to be sent to recipients off of a homepage. E-mail transmissions using special mobile radio are conducted through the Internet.

The same techniques used to connect computer networks, can be used to allow wireless data vendors to send messages back and forth. In the same way, client computers can vary on a network (i.e. different brands, different functionality's, etc.), mobile receiving devices supported by different wireless vendors can differ. For example, a mobile data terminal supported on a CDPD network today, could send a text message originating in e-mail on the terminal, to one or more individuals carrying one-way or two-way alphanumeric pagers. In addition, a two-way pager allows a recipient to send a reply back to the originator through his/her remote e-mail on the mobile data terminal. The same holds true for satellite terminals, and SMR networks.

Working Group #9 distributed a capabilities guideline to multiple vendors to determine what levels of interoperability between commercial vendors may exist based on gateway technology. Responses came in from the satellite, PCS, SMR and paging industries. The results indicate that a level of interoperability could be achieved today across satellite, SMR and paging networks based on their support of the Transmission Control Protocol/Internet Protocol (TCP/IP). Each also support the X.25 wide area network communication standard which allow connectivity provided that network protocols are supported.

If public safety private radio networks supporting digital, (or adapted to transmit analog to digital), can set up a communications server that supports TCP/IP transmission, data messages could be transmitted to commercial wireless networks in the same way that commercial networks achieve connectivity today.

d) Examples of current interoperability

Agencies may use their own local paging providers on an intra or interagency basis. Paging software allows dispatchers to send messages to digital and/or alphanumeric pagers from a single directory and user interface, even though the pagers may reside on multiple networks. As long as dispatchers have the appropriate software on their computers along with the appropriate pager identification numbers listed in their directories, they can send individual or group messages throughout multiple jurisdictions from one or more central locations.

Some providers today offer centralized management of pagers across agencies and/or organizations, even though the pagers operate on multiple networks.

Paging has been interoperating with existing network infrastructures for many years supporting notification applications. Many popular software packages for network management today offer options to allow the software to automatically outdial messages from the network to a commercial paging network, should certain criteria exist. For example, if a computer on the network crashes, the network management software will generate a page to one or more technicians, letting them know that a problem has occurred. Some very sophisticated software packages, will send very specific information to technicians carrying text pagers, indicating the exact location and nature of the problem. Those capabilities can be used today for alert notification

of emergency personnel to let them know that a particular event is about to take place (like a tornado), or of a disaster that has already occurred and requires their response.

Interoperability exists between paging and satellite providers today. The paging industry has taken the lead in developing gateways with satellite vendors which will allow data messages to be originated on either provider's network. Messages are then transmitted to other, and delivered to a device supported by the subscriber's vendor. When recipients reply, the reply is again transferred across multiple networks in a manner transparent to users. For example:

Today it would be possible for an enforcement officer to send a message from a remote location along the US border from a satellite terminal to an admissions clerk carrying a pager at the police station in a nearby US town. The message may let him/her know that a truck load of illegal immigrants will be arriving, the estimated time of arrival, and that they need to be booked. A message may also be sent to the same station asking for additional transportation. Messages can be sent back to the satellite terminal directly from the clerk's two-way pager, through a dispatch operator, or from a PC. Data logs of those transmissions can be printed for reports.

The cellular industry is embracing interoperability agreements between carriers to facilitate nationwide deployment of Cellular Digital Packet Data (CDPD).

Because cellular digital packet data (CDPD) is an open product third party vendors are developing complimentary products for multiple carriers. They include:

- A client-only software solution that allows wireless access to a network LAN
- A PCMCIA card adapter and new wireless modem that accommodates CDPD transmission
- Mail and database connectivity support with major software vendors (ISCWG9027)

The Washington (DC) Metropolitan Police, Alexandria (VA) Police, Virginia State Police, Montgomery County (MD) Police and the Uniformed Division of the Secret Service are all looking at pilot tests to install computer terminals in their cruisers utilizing the CDPD network. It is envisioned that interoperability will be achieved between the above disciplines through the commonality of the CDPD network.

e) Dual-mode devices

This year handheld dual mode satellite and cellular telephones providing voice, fax and data services to and from the PSTN and private networks will become available.(ISCWG9007)

f) Third-party products

Mobile data terminal products

As Commercial Wireless Network Providers rush to launch new services in a highly competitive environment, the ability to focus resources on specialized market segments is somewhat limited.

As new wireless technologies mature, vertical market specialists will develop value added products and services specific to the Public Safety market place.

Third party products that operate on diverse infrastructures, will be key to interoperable communications across commercial networks. Where third party developers support multiple protocols, information exchange between dissimilar networks and devices can be achieved.

Products have already been produced which run on multiple network infrastructures.

An example, is supplier of software and systems for public safety that runs on Cellular Digital Packet Data (CDPD) networks, and a variety of radio networks, including single radio channels, conventional repeaters, and multi-site trunked radio networks. See document ISCWG9053.

The product has been installed in close to 100 sites including Jefferson Borough, Pennsylvania and West Bridgewater, where officers on routine patrol can check for stolen motor vehicles, verify license information, and identify missing and wanted persons. The system will also allow transmission of dispatch information directly to each officer's mobile computer. Exact geographic locations from police cruisers can also be relayed directly to a base unit.

- Each vehicle is equipped with a laptop or "mobile computer" which connects to a wireless network. The department owns the computer hardware and software, but pays a nominal monthly fee to the wireless service provider.
- The Jefferson Borough system relies on an automatic link to the Pennsylvania Criminal Justice Information Network, which in turn is linked to the National Crime Investigation Center (NCIC) and NLETS.
- A Jefferson Borough spokesperson reported that the system, streamlined the flow of critical information, and eliminated redundant tasks". During the first two weeks of operation, the system helped the department identify and capture several wanted persons and recover a number of stolen vehicles.

West Bridgewater police officers, can enter a subject's license plate number in to the computer mounted in the cruiser, and get almost instant feedback on all automo-